Engineering Daily 22 [Home Practice] EV

Current Electricity

Total Marks: 50 **Negative Marks:** 0.25 **Time:** 1 Hour

MCQ 50 marks

1. A completely discharged mobile phone with a 3.85 V – 3000 mAh battery is being charged from a 3.85 V – 5000 mAh power bank. If the charging efficiency is 80%, how many times can the power bank fully charge the phone?

   (A) 1.33 times (B) 1.67 times
   (C) 2.08 times (D) 0.75 times

2. The charge flowing through a cross-section of a conductor varies with time as $q = (5t^2 + 3t)$ C. What is the instantaneous current at $t = 2$ s?

   (A) 20 A (B) 23 A (C) 13 A (D) 26 A

3. The current density in a copper wire ($\rho = 1.7 \times 10^{-8}\ \Omega$m) is 2×10^6 Am^{-2}. What is the magnitude of the electric field inside the wire?

   (A) 3.4 Vm^{-1} (B) 1.18×10^{14} Vm^{-1}
   (C) 0.017 Vm^{-1} (D) 0.034 Vm^{-1}

4. In a wire of cross-sectional area 1 mm^2 carrying a current of 1.6 A, the drift velocity of electrons is 10^{-4} ms^{-1}. What is the free-electron density in the material of the wire?

   (A) 10^{29} m^{-3} (B) 1.6×10^{29} m^{-3}
   (C) 10^{28} m^{-3} (D) 10^{23} m^{-3}

5. A uniform wire of resistance 48 Ω is folded in half twice in succession to form a thick four-layered wire. What is the resistance of the new wire?

   (A) 6 Ω (B) 1.5 Ω (C) 12 Ω (D) 3 Ω

6. A wire is stretched so that its length increases by 10%, keeping its volume unchanged. By what percentage does its resistance increase?

   (A) 11% (B) 10% (C) 20% (D) 21%

7. The resistance of a conductor at 50°C is 1.2 times its resistance at 0°C. At what temperature will its resistance be 1.5 times its resistance at 0°C?

   (A) 150°C (B) 100°C (C) 125°C (D) 75°C

8. Wire A has twice the length of wire B and half its radius. If the two wires have equal resistance, what is the ratio of the resistivities of their materials, $\rho_A : \rho_B$?

   (A) 1 : 4 (B) 1 : 8 (C) 1 : 2 (D) 8 : 1

9. In a bridge network, the path from A to B via C has resistors of 2 Ω and 4 Ω, the path from A to B via D has resistors of 3 Ω and 6 Ω, and a 5 Ω resistor connects C and D. What is the equivalent resistance between A and B?

   (A) 2.9 Ω (B) 5 Ω (C) 4.5 Ω (D) 3.6 Ω

10. The open-circuit voltage of a battery is 9 V. When it is connected to an external resistor, a current of 2 A flows and the terminal voltage is 8 V. What is the value of the external resistance?

    (A) 4.5 Ω (B) 0.5 Ω (C) 4 Ω (D) 3.5 Ω

11. Into how many equal parts must a wire of resistance 12 Ω be cut so that the parts, connected in parallel, give an equivalent resistance of 0.75 Ω?

    (A) 8 (B) 4 (C) 16 (D) 2

12. The internal resistance of a cell is 1 Ω. For what value of the external resistance will the terminal voltage be 80% of the emf?

    (A) 4 Ω (B) 5 Ω (C) 0.25 Ω (D) 0.8 Ω

13. While connecting 10 cells, each of 2 V and internal resistance 0.5 Ω, in series, one cell is mistakenly connected in reverse. What is the current when the combination is connected to an external resistance of 5 Ω?

    (A) 1.45 A (B) 2 A (C) 1.6 A (D) 1.8 A

14. Several identical cells connected in series to an external resistance give a current of 3 A. When the connection of one cell is reversed, the current becomes 2 A. How many cells are there?

    (A) 8 (B) 6 (C) 5 (D) 4

15. How should 16 cells, each of 1.5 V and internal resistance 0.5 Ω, be arranged to obtain the maximum current through an external resistance of 2 Ω?

    (A) 8 rows with 2 cells in each row
    (B) All in series
    (C) 4 rows with 4 cells in each row
    (D) 2 rows with 8 cells in each row

16. A battery of emf 12 V can deliver a maximum power of 9 W to a variable external resistance. What is the internal resistance of the battery?

    (A) 1.33 Ω (B) 16 Ω (C) 8 Ω (D) 4 Ω

17. In a bridge network, the resistances are 5 Ω from A to C, 10 Ω from C to B, 10 Ω from A to D and 5 Ω from D to B, and a 5 Ω resistor connects C and D. What is the equivalent resistance between A and B?

    (A) 7 Ω (B) 5 Ω (C) 7.5 Ω (D) 6.67 Ω

18. In a meter bridge, with resistances P in the left gap and Q in the right gap, the null point is 40 cm from the left end. When a 10 Ω resistor is connected in series with P, the null point moves to the middle of the wire. What is the value of P ?

    (A) 10 Ω (B) 15 Ω (C) 20 Ω (D) 30 Ω

19. In a meter bridge, a wire of length 2 m and cross-sectional area 0.5 mm^2 is placed in the left gap and a 10 Ω resistor in the right gap, and the null point is 25 cm from the left end. What is the resistivity of the material of the wire?

(A) 3.33×10^{-7} Ωm (B) 1.67×10^{-6} Ωm

(C) 8.33×10^{-7} Ωm (D) 7.5×10^{-6} Ωm

20. On a 4 m long potentiometer wire, the balancing length for a cell is 1.5 m. If the potential difference across the ends of the wire is kept the same but a similar wire 10 m long is used, what will be the balancing length for the same cell?

(A) 1.5 m (B) 0.6 m (C) 6 m (D) 3.75 m

21. A cell of internal resistance 0.5 Ω has an open-circuit balancing length of 100 cm on a potentiometer. What will the new balancing length be when a 2 Ω resistor is connected across the cell?

(A) 20 cm (B) 80 cm (C) 125 cm (D) 75 cm

22. The effective resistance of an ammeter made by connecting a shunt to a galvanometer of resistance 50 Ω is 0.5 Ω. What is the value of the shunt?

(A) 0.505 Ω (B) 0.495 Ω

(C) 0.5 Ω (D) 5.05 Ω

23. A shunt of 2 Ω is connected to a galvanometer of resistance 48 Ω to make an ammeter of range 0–5 A. What is the full-scale current of the galvanometer?

(A) 0.1 A (B) 0.2 A (C) 0.21 A (D) 0.24 A

24. A 4 Ω resistor is connected to a battery of emf 10 V and internal resistance 1 Ω. If a voltmeter of resistance 20 Ω is connected across the 4 Ω resistor, what does it read?

(A) 10 V (B) 7.69 V (C) 8 V (D) 6.67 V

25. In a circuit, a voltmeter is mistakenly connected in series with a resistor. As a result—

(A) the circuit current will increase greatly

(B) the voltmeter will read zero

(C) the voltmeter will burn out

(D) the circuit current will be nearly zero and the voltmeter will show nearly the source voltage

26. How long will an 80% efficient 2 kW water heater take to raise the temperature of 10 kg of water from 20°C to 60°C? (Specific heat of water 4200 $Jkg^{-1}K^{-1}$)

(A) 17.5 min (B) 21.9 min

(C) 14 min (D) 11.2 min

27. Two resistors dissipate 4.5 W when connected in series across a 12 V source and 24 W when connected in parallel across it. What are the values of the resistors?

(A) 12 Ω and 6 Ω (B) 24 Ω and 8 Ω

(C) 20 Ω and 12 Ω (D) 16 Ω and 16 Ω

28. The length of the filament of a '220 V – 100 W' bulb is reduced by 10% and the bulb is operated on the same 220 V source. What will its power be? (Cross-section unchanged)

(A) 111.1 W (B) 90 W

(C) 110 W (D) 123.5 W

29. A copper wire and an iron wire of equal length and equal cross-section are connected in series to a source. If the resistivity of iron is 6 times that of copper, what is the ratio of the heat produced in the copper wire to that in the iron wire in the same time?

(A) 1 : 6 (B) 6 : 1 (C) 1 : 36 (D) 1 : 1

30. In a shop, 3 tubelights of 40 W run 8 h daily and a 200 W refrigerator runs all day. If each unit costs 8 taka, what is the bill for 30 days?

(A) 1497.6 taka (B) 1152 taka

(C) 1382.4 taka (D) 172.8 taka

31. Two cells of 8 V and 4 V (each with internal resistance 2 Ω) are connected in parallel with their positive terminals together, with no external resistance. What is the terminal voltage of the combination?

(A) 12 V (B) 8 V (C) 6 V (D) 4 V

32. A battery of emf 6 V and internal resistance 2 Ω is to deliver 4 W to an external resistance. Which pair gives the possible values of the external resistance?

(A) 4 Ω and 8 Ω (B) 2 Ω and 4 Ω

(C) 1 Ω and 2 Ω (D) 1 Ω and 4 Ω

33. The resistance of a coil is 11.2 Ω at 30°C and 13.2 Ω at 80°C. What is the resistance of the coil at 0°C?

(A) 10.4 Ω (B) 10 Ω (C) 9.6 Ω (D) 11 Ω

34. When a voltmeter of resistance 90 Ω is connected across a cell it reads 1.35 V, and when another voltmeter of resistance 190 Ω is connected it reads 1.425 V. What is the internal resistance of the cell?

(A) 10 Ω (B) 5 Ω (C) 20 Ω (D) 15 Ω

35. What is the dimensional formula of resistance?

(A) $[ML^2T^{-3}A^{-1}]$ (B) $[ML^3T^{-3}A^{-2}]$

(C) $[ML^2T^{-3}A^{-2}]$ (D) $[ML^2T^{-2}A^{-2}]$

36. Resistors of 2 Ω, 3 Ω and 6 Ω are connected in parallel and a 4 Ω resistor is connected in series with them, and the combination is connected to an ideal 10 V source. What is the power dissipated in the 6 Ω resistor?

(A) 1.33 W (B) 0.67 W (C) 16.67 W (D) 2 W

37. Two wires of the same material and the same length have a diameter ratio of 1 : 2. If they are connected in parallel across the same potential difference, what is the ratio of the drift velocities of electrons in them?

(A) 4 : 1 (B) 2 : 1 (C) 1 : 1 (D) 1 : 4

38. Each of the 12 edges of a cube has a resistance of 12 Ω. What is the equivalent resistance between the two ends of any one edge of the cube?

Ⓐ 9 Ω Ⓑ 10 Ω Ⓒ 7 Ω Ⓓ 6 Ω

39. The current through a 2 Ω resistor decreases uniformly from 10 A to zero in 4 s. How much heat is produced in the resistor during this time?

Ⓐ 800 J Ⓑ 200 J

Ⓒ 266.7 J Ⓓ 400 J

40. A battery of emf 12 V and internal resistance 0.5 Ω is being charged at 4 A. What is the efficiency of the charging process?

Ⓐ 75% Ⓑ 85.7% Ⓒ 92.3% Ⓓ 83.3%

41. An ammeter of resistance 0.5 Ω is connected in series with a resistor, and a voltmeter is connected across the ammeter and the resistor together. If the ammeter reads 2 A and the voltmeter reads 10 V, what is the actual value of the resistor?

Ⓐ 5 Ω Ⓑ 4.5 Ω Ⓒ 4 Ω Ⓓ 5.5 Ω

42. A 100 Ω rheostat is connected across an ideal 10 V source as a potential divider with its slider exactly at the middle. If a 50 Ω load is connected in parallel with the lower half, what will be the potential difference across the load?

Ⓐ 3.33 V Ⓑ 2.5 V Ⓒ 5 V Ⓓ 6.67 V

43. Five cells, each of 2 V and internal resistance 1.5 Ω, are connected in parallel to an external resistance of 0.7 Ω. What is the terminal voltage of the combination?

Ⓐ 1.4 V Ⓑ 2 V Ⓒ 0.6 V Ⓓ 1.6 V

44. The 220 V main line of a house has a 15 A fuse. With a 1.5 kW heater switched on, what is the maximum number of '220 V – 100 W' bulbs that can be safely lit at the same time?

Ⓐ 19 Ⓑ 33 Ⓒ 15 Ⓓ 18

45. Two heaters rated '220 V – 1000 W' and '220 V – 500 W' are connected in series across a 220 V source. What is the total power?

Ⓐ 333.3 W Ⓑ 1500 W

Ⓒ 750 W Ⓓ 666.7 W

46. Two wires of the same material have a length ratio of 1 : 2 and a radius ratio of 2 : 1. If they are connected in parallel to the same source, what is the ratio of the heat produced in them in the same time?

Ⓐ 4 : 1 Ⓑ 8 : 1 Ⓒ 2 : 1 Ⓓ 1 : 8

47. Two bulbs rated '220 V – 60 W' and '220 V – 40 W' are connected in series across a 440 V line. What will happen?

Ⓐ The 40 W bulb will fuse

Ⓑ The 60 W bulb will fuse

Ⓒ Both bulbs will glow normally

Ⓓ Both bulbs will glow dimly

48. Two parallel branches are connected across an ideal 12 V battery: the first has 4 Ω and 8 Ω in series, and the second has 6 Ω and 6 Ω in series (in both branches the first resistor is towards the positive terminal). If the midpoints of the two branches are joined by a 10 Ω resistor, what is the current through it?

Ⓐ 0.353 A Ⓑ 0.2 A

Ⓒ 0.1 A Ⓓ 0.128 A

49. n identical cells, each of emf E and internal resistance r, are connected in series to form a closed loop (no external resistance). What is the potential difference across the terminals of any one cell?

Ⓐ E Ⓑ nE Ⓒ $\frac{E}{n}$ Ⓓ Zero

50. The I–V graphs (with I on the vertical axis) of two conductors are straight lines through the origin with slopes of 2 S and 0.5 S respectively. What is the current when the two conductors are connected in series to an ideal 10 V source?

Ⓐ 25 A Ⓑ 0.4 A Ⓒ 4 A Ⓓ 2 A